

What properties of CMEs are most important for space weather?

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Severe space weather is characterized by intense particle radiation from the Sun and major geomagnetic storm caused by magnetized solar plasmas arriving at Earth. Coronal mass ejections (CMEs) are key players in both these aspects. CMEs traveling at super-Alfvénic speeds drive fast-mode MHD shocks that create the high levels of particle radiation. When a CME arrives at Earth, the CME-associated magnetic fields reconnect with Earth's magnetopause fields resulting in solar plasma entry into the magnetosphere and a geomagnetic storm depending on the magnetic structure of the CME. Particle radiation starts affecting geospace as soon as the CMEs leave the Sun and the geospace may be immersed in the radiation for several days. On the other hand, the geomagnetic storm happens only upon CME arrival at Earth. The requirements for the production of particles and magnetic storms by CMEs are different in a number of respects: solar source location, CME magnetic structure, conditions in the ambient solar wind, and shock-driving ability of CMEs. Intense shocks arriving at Earth have additional space weather effects such as sudden impulse that shrinks the magnetosphere often exposing satellites in geosynchronous orbit to the solar wind and energetic storm particle events. This paper highlights these space weather effects using CME observations space and ground based instruments during of solar cycles 23 and 24.